Original Article

Risk assessment of the emergency processes: Healthcare failure mode and effect analysis

Yasamin Molavi Taleghani[1], Fatemeh Rezaei[1], Hojat Sheikhbardsiri[2]

[1] *Health Management and Economics Research Center, School of Management and Medical Information, Isfahan University of Medical Science, Isfahan, Iran*

[2] *Department of Disaster and Emergency Medical Management Center, Kerman University of Medical Science, Kerman, Iran*

Corresponding Author: *Hojat Sheikhbardsiri, Email: hojat.sheikhbardsiri@gmail.com*

BACKGROUND: Ensuring about the patient's safety is the first vital step in improving the quality of care and the emergency ward is known as a high-risk area in treatment health care. The present study was conducted to evaluate the selected risk processes of emergency surgery department of a treatment-educational Qaem center in Mashhad by using analysis method of the conditions and failure effects in health care.

METHODS: In this study, in combination (qualitative action research and quantitative cross-sectional), failure modes and effects of 5 high-risk procedures of the emergency surgery department were identified and analyzed according to Healthcare Failure Mode and Effects Analysis (HFMEA). To classify the failure modes from the "nursing errors in clinical management model (NECM)", the classification of the effective causes of error from "Eindhoven model" and determination of the strategies to improve from the "theory of solving problem by an inventive method" were used. To analyze the quantitative data of descriptive statistics (total points) and to analyze the qualitative data, content analysis and agreement of comments of the members were used.

RESULTS: In 5 selected processes by "voting method using rating", 23 steps, 61 sub-processes and 217 potential failure modes were identified by HFMEA. 25 (11.5%) failure modes as the high risk errors were detected and transferred to the decision tree. The most and the least failure modes were placed in the categories of care errors (54.7%) and knowledge and skill (9.5%), respectively. Also, 29.4% of preventive measures were in the category of human resource management strategy.

CONCLUSION: "Revision and re-engineering of processes", "continuous monitoring of the works", "preparation and revision of operating procedures and policies", "developing the criteria for evaluating the performance of the personnel", "designing a suitable educational content for needs of employee", "training patients", "reducing the workload and power shortage", "improving team communication" and "preventive management of equipment's" were on the agenda as the guidelines.

KEY WORDS: Emergency; Risk assessment; Healthcare failure mode

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INTRODUCTION

Health care brings benefits to patients basically, but it can put patients at risk of adverse events and medical errors at the same time.[1] Thus, maintaining patient safety is proposed as the main concern in providing treatment and health care.[2] Also, emergency ward is known as a complex, dynamic and prone to medical errors in health care systems.[3,4] In the emergency conditions, time is short for the critical thinking and it leads to delay in decision-making and consequently an increase in adverse events.[3] The results indicate that almost one person in 10 people admitted in hospitals experiences a traumatic event that about half of them are preventable.[5] Also according to the performed estimations, 3% of all hospital errors are related

to the emergency ward.[6] As well as traumatic events in about 10% of patients with surgery that is more common in the emergency section.[7] The results from the New Zealand study indicated that 3.4% of deaths were related to medical mistakes which are preventable.[8] Prevention of treatment errors is the basic rule in the quality of health care.[9] In all programs of the quality improvement, error prevention and risk management approaches are the basic pillars in the creation, establishment and implementation of management systems in organizations.[10] One of the most reliable error prevention and risk management programs of the National Center of Patient Safety and the Commission on Accreditation in the United States of America is Healthcare Failure Mode and Effects Analysis (HFMEA).[11] In fact, HFMEA is a prospective and systematic approach to identify and avoid the potential errors before they occur which is specially designed for treatment and healthcare organizations.[12,13] This approach is good for identification and prioritization of risks to improve patient safety and reduce the potential errors of each system before they occur.[14,15] The results indicate that the number of medical events from 2008 to 2009 and after implementation of risk management programs by the National Center for Patient Safety was reached to 2412 from 3643.[16] Since maintaining and protection of patient safety is addressed as the main concern in healthcare systems[2] and also due to the emergency ward is known as a high-risk area in healthcare[17] and in high percentages of patients is the first contact unit of the patient with hospital care,[18] the present study was conducted with the aim of risk assessment of the selected processes in the emergency surgery ward of Qaem Treatment-Educational Center in Mashhad with the method of HFMEA.

METHODS

In this study and as a combination (qualitative action research and quantitative cross-sectional), failure modes and effects were identified and analyzed with the method of HFMEA. This study was conducted from December 2012 to June 2013 on five selected processes in the emergency surgery ward of the Qaem Treatment-Educational Center in Mashhad. Qaem Hospital as a first-class and general hospital with 870 active beds, 18 sections and 7 emergency and having para-clinical services and clinics is one of the biggest treatment-educational centers in the area and country. This center is a place for researches of medical education and education of students in specialized and ultra-specialized levels in addition to treating patients. All information after reaching consensus on team comments at the end of each step was entered to HFMEA work sheet. It should be noted that the time taken to carry out the study was 42 hours. The stages of this research according to the five explained steps of the HFMEA method by the National Center for Patient Safety[11] were carried out as below that had some differences with the proposed model according to the conditions in the running:

Step one: selection of a high-risk process

Using the method of "voting method using rating", ten people of the emergency surgery members were asked to classify five processes from a total of 20 processes listed in that section with regard to the effect severity of the existing problems on patients' dissatisfaction, the possibility of damages caused by process problems, and the need to solve them, from one to five. Then the data of vote were finalized and prioritized according to the matrix or Borda function[19,20] and 5 processes with priority were selected to manage risk. Borda function is the sum of voters who preferred each option over the others and determine the priority of the problem.[21]

Step two: assembling the team

In this process, 17 persons participated in as the members of the HFMEA team including the responsible person of risk management (team leader), an expert in health services (team advisor), an assistant professor in the emergency department, the head of the emergency ward, an adviser physician, the supervisor, two assistants (residents), a technical manager of radiology unit, two nurses, a receptionist, a triage nurse, the chief of the laboratory, a laboratory expert, and a secretary.

Step three: graphically describing the processes

In this step the diagram of selected processes and their sub-processes were drawn by observation and interview. The validity of processes and sub-processes flow was assessed in a focus discussion group by team members, and proper correction was made. The final process flow was designed by Visio.

Step four: conducting hazard analysis which was done in 4 phases:

First phase: determining the potential failure modes

In this stage, by means of triangle model,[22] errors in every sub-process of selected processes were identified and they were classified according to the nursing errors

in clinical management model (NECM).[23] In the triangulated approach, failure modes are obtained by three approaches of literature reviews: ward observations and interviews with patients and staff; brainstorming sessions by members of the project; and focus groups with HFMEA teams.[22] Failure modes according to the nursing errors in the NECM were categorized in 4 main groups of communication, care process, administrative and knowledge, and skill-based errors.[23]

Second phase: determining the hazard score

This score was obtained through a priority matrix (by multiplying the two factors of severity and probability), and it was recorded on the HFMEA worksheet. The errors were grouped according to their hazard scores into four intervention levels, i.e., emergency, urgency, programming, and monitoring.[24] For determination of the probability of the failures, the sum of the team's scores was used with consideration of a coefficient for each team member. For the severity of the failures, the team members' consensus along with consideration of weight for the severity of failures was used. In the final worksheet, we calculated and documented in the final worksheet the sum of failure mode severity scores according to team members' opinions and by considering weights for the failure mode severity dimensions, and we calculated the sum of the failure mode probability scores based on the involved personnel's opinions (also with considering the coefficient for each person) (Table 1).

Third phase: designing decision making tree

The non-acceptable risks (risk score level more than 8) were transferred to decision tree. Decisions for proceeding or stopping each of failure modes were made based on three items: weakness points, existing control, and detectability.

Fourth phase

In this phase, through cause and effect analysis sessions, effective causes were identified for failure modes which obtain positive response in weakness point and reach negative response in detectability and existing control measures and they are classified by means of Eindhoven model.[25] According to the ECM model, root causes of failures can be categorized in two main groups: latent errors (technical and organizational) and active errors (human errors).

Step five: actions and outcome measures which were performed in two phases

The first phase

The suggested confronting strategies for each factor that affect failure mode were presented in accept, control or eliminate forms.

The second phase

Redesigning the process and improving strategies for each cause of error with a score≥8 in the team meetings through "theory of problem solving by an inventive method"[26,27] were provided and classified with inspiring by the proposed model of "classification of preventive strategies in incidence of medical errors".[9,28] Finally, the practicability of implementation of any approach with regard to resources of the organization were evaluated.

RESULTS

By implementing the voting method using rating, from among the 20 processes in the emergency surgery, 5 processes with the Borda-number[29] were selected for the process of first visit of patient,[24] for the process of outpatient admission,[18] for the process of performing, sending and tracking the laboratory results,[12] for the process of patient radiology[9] and for the process of nursing and patient care.

According to the results, for 5 selected processes per 23 listed steps, 61 sub-processes and 217 failure modes were identified. The number of identified failure modes, number of intervention levels, and classification of failure modes for the selected processes based on the proposed model are shown by the association of "management of nursing error" (Table 2). In total, 25 failure modes were identified as the high-risk and unacceptable failure mode (hazard score≥8) in 5 selected processes and transferred to the decision tree. Because of the plurality of high-risk failure modes (hazard score≥8), only some of the high-risk and unacceptable failure modes are provided in the HFMEA worksheet (Table 3). The classification of causes of high-risk and non-acceptable risk (hazard score≥8) is shown based on Eindhoven model (Table 4). The classification of strategies

Table 1. Error scoring matrix and classification of intervention levels

Intervention level	Probability	Catastrophic (4)	Important (3)	Intermediate (2)	Minor (1)
Emergency	Usual (4)	16	12	8	4
Urgent	Sometimes (3)	12	9	6	3
Programming	Unusual (2)	8	6	4	2
Monitoring	Rare (1)	4	3	2	1

Table 2. Distribution of failure modes in each area of the error scoring matrix and classification of failure modes based on the model of management association of nursing error for the selected emergency surgery processes

High-risk processes of emergency surgery	Number of sub-processes	Number of failure modes	Number of intervention levels categories				Frequency percentage of failure modes based on association model of "management of nursing error"			
			Emergency levels	Urgent levels	Programing levels	Monitoring levels	Care process errors	Communication errors	Administrative process errors	Knowledge and skill errors
Care and patients nursing										
Ordered by physician	2	9	0	0	8	1	7	4	3	0
Checking and importing of illegible prescriptions by nurse patient	2	5	0	0	5	0	5	0	2	2
Executing the physician's commands and nursing records	2	16	0	0	16	0	11	4	3	2
Collection and delivery of patients records to the secretory	1	4	0	0	2	2	3	1	1	0
First visit of the patient										
Filing in the ward	1	4	0	0	3	1	4	0	1	0
History taken by the intern and examination by the resident	5	19	0	0	18	1	13	8	7	1
Doing the tests and required graphs	1	4	0	0	4	0	4	1	1	1
Checking and implementation of physician's commands	3	9	0	0	7	2	8	4	9	2
Patient radiology										
Request for radiology	2	8	0	2	5	1	5	2	0	1
Request a graph with surgical emergency admission	2	6	0	0	6	0	1	2	2	2
Request a graph from the ward to the radiology unit	3	6	0	0	6	0	2	3	2	0
Transfer patients to the radiology unit	1	7	0	5	2	0	8	0	1	0
Doing radiology	1	4	0	0	2	2	4	0	1	0
Get answers and report	2	5	0	0	5	0	5	0	1	1
Laboratory management										
Request for the laboratory test	6	19	0	4	14	1	17	7	0	1
Collecting and sending samples	4	16	0	3	13	0	13	2	5	4
Sample analysis	4	15	0	3	12	0	14	0	6	1
Laboratory test result issue	1	4	0	3	1	0	4	0	2	2
Report to the related physician	2	5	0	1	4	0	4	0	0	1
Outpatient admission										
Accepting patient in triage	4	15	0	4	11	0	15	6	1	0
Patient transfer to the emergency surgery	2	7	0	0	7	0	7	3	0	0
Central reception and temporary early filing of hospitalization	4	14	0	0	3	11	14	4	0	0
Patient admission in the ED surgery	3	7	0	0	3	4	6	1	1	0
Total score	61	217	0	25	166	26	181	54	53	21

It may put failure modes in different categories based on management association of nursing error.

Table 3. Classification of the basic causes of failure modes with error score≥8 based on Eindhoven model

Error cause	Care and patients nursing	First visit of the patient	Laboratory management	Outpatient admission	Patient radiology	Total
Technical						
External	0	0	0	0	0	0
Design	0	0	0	0	1	1
Structure	0	0	2	2	1	5
Material	0	0	3	0	1	4
Organizational						
External	0	0	6	1	4	11
Transfer of knowledge	0	0	2	2	2	6
Protocols	0	0	1	1	2	4
Priorities management	0	0	1	0	1	2
Culture	0	0	3	0	0	3
Human factors						
External	0	0	6	0	1	7
Knowledge based	0	0	3	0	2	5
Competence	0	0	1	0	0	1
Cooperation	0	0	3	0	3	6
Evaluation	0	0	0	1	0	1
Action	0	0	1	0	0	1
Monitoring	0	0	4	0	0	4
Slips	0	0	3	1	2	6
Falling	0	0	0	0	0	0
Other factors						
Related to patients	0	0	0	3	2	5
Unclassified factors	0	0	1	1	0	2
Total	0	0	40	12	22	74

Table 4. The worksheet of failure modes techniques and HFMEA for some high-risk failure modes of the selected emergency surgery processes

Hazard analysis									Action and outcome measures	
		Scoring			Decision tree analysis					
Failure mode	Potential causes	Severity	Occu-rrence	Hazard score	Weakness point	Existing control measures	Detecta-bility	Proceed?	Action type	Actions or rate for stopping
Recording the incorrect information in triage sheet	⟶	3	3	9	⟶	No	No	Yes		
	1) Giving false information from the patient or not having knowledgeable person	3	3	9	⟶	No	No	Yes	C	1) Assessing the patient's ability to communicate effectively with healthcare providing; 2) Detailed examination of the patient and not limited to what patient said
	2) Lack of a correct communication of physician with patient	3	2	6	⟶	No	No	Yes	C	1) Assessing the patient's ability to communicate effectively with healthcare providing; 2) Developing the criteria of performance evaluation and monitoring clinical process; 3)Training course of effective communication and respect to the rights of service recipients
	3) Lack of confidence of the patient and patient's caregiver to the nurse	3	3	9	⟶	No	Yes	No	C	1) Assessing the ability of patient to communicate effectively with healthcare provider; 2) Catches the patient's desire for giving information; 3) Implementation of the ethics nursing codes in the hospital for better interaction with the patient
Error in patient transfer to the emergency surgery (incorrect refer of patient)	⟶	3	3	9	⟶	No	No	Yes		
	1) Incorrect decision by physician	3	2	6	⟶	No	No	Yes	C	1) Correct communication with patient; 2) Detailed examination and complete knowledge of the patient's clinical condition; 3) Correct history taking from the patient; 4) Taking into account the advice of other clinicians by the service provider if necessary
	2) Lack of a good protocol to determine the correct situation of patient	3	3	9	⟶	No	Yes	No	C	1) Assessing the patient's ability to communicate effectively with healthcare provider; 2) Detailed examination of the patient and not limited to what patient said
Delay to refer patient to the radiology	⟶	3	3	9	⟶	No	No	Yes		
	1) Absence of nurse aid or the intern	3	3	9	⟶	No	Yes	No	C	1) Coordination in medical team; 2) Sharing information in medical team; 3) Responsibility about patient safety
	2) Lack of cooperation of patient and being unstable of the patient	3	4	12	⟶	No	No	Yes	C	1) Cooperation for receiving information and consequences of each method; 2) Awareness of patient about the need to do radiology; 3) Monitoring the work process; 4) To pass information sharing between the medical team
	3) Lack of cooperation, coordination and team problems between radiology and emergency surgery	3	3	9	⟶	No	No	Yes	C	1) Sharing the information between medical team; 2) Training courses of team work; 3) Continuous monitoring of doing process; 4) Coordinated acting of medical team
	4) Overcrowding in radiology and or emergency surgery	3	3	9	⟶	No	Yes	No	C	1) Supply of additional power; 2) Fitting the work volume with number of human resources; 3) Coordination of medical team and establishment of stress management; 4) Determination of standard range and keeping client data in the standard range; 5) Coordination between radiology and surgery wards
Unnecessary graph for patient is requested by the physician	⟶	3	3	9	⟶	No	No	Yes		
	1) Lack of correct communication of physician with the patient	3	2	6	⟶	No	No	Yes	C	1) Assessing the patient's ability to communicate effectively with healthcare provider; 2) Developing criteria of performance evaluation and monitoring the clinical process; 3) Training course of effective communication and respect to the rights of service recipients
	2) Lack of knowledge and enough skill by physician	3	2	6	⟶	No	No	Yes	C	1) Encourage physicians to ask about the ambiguity (taking into account the comments of other experts); 2) Periodic training for clinical staff
Delay in the beginning of the test on the intended sample in laboratory	⟶	3	4	12	⟶	No	No	Yes		
	1) Overcrowding of the laboratory	3	4	12	⟶	No	Yes	No	C	1) Reducing the workload and arranging the tables of work shifts and avoid of row shifts; 2) Supply of additional power; 3) Fit the work volume with the number of human resources; 4) Coordination of medical team and establishment of stress management
	2) Lack of awareness of the importance of the subject	3	3	9	⟶	No	No	Yes	C	1) Performing a justification course at the beginning; 2) Determination a leader or supervisor for the team; 3) Sharing information with medical team; 4) Continuous monitoring of healthcare providing
	3) Lack of monitoring of a technical responsible on the process of doing work	3	3	9	⟶	No	No	Yes	C	1) Periodic monitoring and evaluation of laboratory; 2) Checking the competence of the team leader and responsible person; 3) Continuous monitoring of doing processes
Failure (error) in entering test answer in the system through laboratory	⟶	3	3	9	⟶	No	No	Yes	C	
	1) High work volume and staff fatigue	3	4	12	⟶	No	No	Yes	C	1) Programing and management of actions during the shift; 2) Work division; 3) Setting shift tables and lack of giving ling shifts
	2) Lack of enough experience	3	2	6	⟶	No	No	Yes	C	1) Evaluation and control of activity and checking the final test answers by technical manager; 2) Developing the careers of introduction of new entrants personnel to the ward's criteria

and the proposed preventive approaches through the theory of problem solving by an inventive method based on the proposed model are shown in Table 5.

DISCUSSION

Using the five-fold stages model HFMEA proposed here by the patient immunity national center, we dealt with the identification of the emergency surgery section selected processes possible failures, factors influencing each of the failure modes, and determination of the improvement solutions and strategies. But, according to the case study conditions and for eliminating the model practical limitations, there were observed differences in the suggested patterns. The major discrepancies include: 1) selection of high-risk processes through some sort of

Table 5. Classification of strategies and preventive measures for causes of high-risk error modes (risk score ≥8)

Strategy classification	Improvement strategy by means of the TRIZ method	Care and patients nursing	First visit of the patient	Patient radiology	Laboratory management	Outpatient admission	Total
Human resources management	Determination a supervisor for treatment team, evaluation the competency of team leader, conducting periodical assessment and offering feedback to the personnel, Inform treatment team by necessary information, defining the responsibilities and announcing them, reducing the work load and correcting the lack of work forces, continuous supervision and controlling the performance procedures and adjusting the workload with staff.	0	0	17	44	7	68
Installation of electronic prescribing system	Implementation procedure on drug combination.	0	0	0	1	0	1
Making people accountable to patient's safety	Readable information in patients clinical documents, all reports must have stamp, signature, date and time, culturally appropriate environment for patient safety and deployment an incident reporting system, encouraging the staff to ask question in case of obscurity and resolving the issue of lack of man power, detachment and pursuing the test results in form of root analysis of the events and reporting the critical results.	0	0	3	7	2	12
Medical equipment management and process standardization	Regular calibration of medical equipment, emergency service of medical equipment and devices, checklists for maintenance of the tools and facility management, purchasing of protective equipment, creating a qualitative committee and monthly views of the equipment of radiology unit.	0	0	6	8	3	17
Improvement of patient identification process	Applying key identifiers in patient identification, improvement of the patient's recognition processes and revising the guidelines for the correct recognition of the patients.	0	0	0	6	0	6
Making clear and transparent policies and procedures	The re-engineering of the process, preparing and organizing the executive guidelines and protocols, preparing new forms with special parts, facilitating the processes and removing the unnecessary steps, designing a special check-list for evaluation of the patient's transition between emergency and radiology units, revision policies, simplifying the process and eliminating unnecessary steps and audits process.	0	0	5	9	6	20
Making sure about availability of suitable technology for quality improvement	Fundamental improving of the software for entering the physician's commands for tests.	0	0	0	3	1	4
Continuous training and briefing care providers at the beginning of employment	Re-training courses and preparing proper training content according to the needs of the personnel, the scientific training for prescription writing and continuous medical training for the physicians, training of recommendation and instructions, continuing the re-training programs for physicians, training of recommendation and instructions.	0	0	7	16	3	26
Participating patients in treatment process	His/her accompanying person and teaching all the regulations of the sector and offering the sufficient data and patient's training, patient's contribution by making effective relationship with them, development of educational patients.	0	0	5	1	7	13
Implementing and monitoring suitable changes in clinical processes based on analysis of reliable data	Continuous supervision, defining the periodical performance assessment criteria and providing feedback to the personnel, introducing a reference laboratory and performing some of the important tests randomly in various periods as binary tests by the hospital laboratory and the reference lab, monitoring on following up standards.	0	0	7	13	2	22
Promotion of communication amongst treatment team members	Don't use of abbreviations, accurate documentation of all oral (telephone) orders, complete registration of the data, obeying the oral commands only in urgent cases.	0	0	0	2	3	5
Team work	Coordination of treatment team, holding teamwork training courses, improvement of the inter-sectorial relations and the supervision of the person responsible for the shift on the work in sectors, improving the team relations.	0	0	13	22	2	37
Total		0	0	63	132	36	231

polling method via making use of ranking method; 2) failure classification within the nursing failure management model framework; 3) designing more comprehensive and conclusive methods for failure level score determination; 4) failure factors classification based on the Eindhoven model; and 5) failure classification within the framework of medical failure preventive strategies classification model. To prioritize and select the high-risk processes, voting method using rating was used to select the high-risk process;[21] whereas Anderson et al[22] used the risk-assessment matrix and the average error score for selection and periodization of high-risk process in the surgery ward.

In the present study, a multidisciplinary team was used to identify and assess risk in the emergency surgery ward. The study results of Dominici et al[29] indicate that it is important to evaluate the results of application of HFMEA in the quality of patient care and form multidisciplinary teams to identify and classify possible risks. Since the first step in reducing health care errors is to identify the failure modes, a comprehensive model must be used to categorize all failure modes, and help to identify and compare them.[30,31] Therefore, we used nursing error management model to group failure modes of the selected processes in the emergency surgery ward. According to Dehnavieh et al,[4] the most failure modes were in the categories of care errors (54.7%), communication errors (20.5%), administrative errors (15.1%) and knowledge and skill errors, respectively, which are in consistent with the results of the present study. In most studies of HFMEA, the variability of ability to detect failure mode has been eliminated, because the concept of detection risk is hidden in the indicator of degree of occurrence and low possibility of discovering many risks of the health sector.[32] If the error report system in the healthcare sector is applied comprehensively and as a general system in the country, the problem will be resolved.[33]

In the present study, the incidence and error possibility were determined individually and independently. Independent scoring of team members has the advantage of wearing off the halo effect (cognitive bias caused by an observers' overall impression of a person or situation), which exists in group discussions.[22] In addition, the intervention levels of "emergency", "urgent", "programing" and "monitoring" for each failure mode were predicted with regard to the score of error level. The advantage of this method is that due to the lack of resources of organization, corrective actions and focus on reducing the risk of errors is due to the levels of intervention.[24] According to Bonfant et al,[24] in 93 errors in the dialysis ward, 0%, 9.6%, 38.7% and 51.6% were placed in the intervention area of emergency, urgent area, programing area and monitoring area, respectively, which are consistent with our findings.

Eindhoven model tested in different industries including hospital is more comprehensive than other models.[34] Using the Eindhoven model, Hung et al[20] discussed the causes of high-risks errors in the selected processes in the emergency surgery ward. They found that 39.7%, 10.4%, 42.4% and 6.8% were related to the human factors, technical factors, organization factors and other factors respectively, which are in consistent with the results of the present study. Most studies using the Eindhoven model showed that the percentages of human and organization factors are higher than those of other factors because of individual prejudices prevailing in each organization.[9,25,35] Moreover, for the safety of patients, ensuring the adequacy of staff, re-designing of the systems and concurrent attention to the obvious and hidden causes are necessary to detect and correct the errors on time.[32] Due to the limited resources in each healthcare organization to implement strategies and eliminate the effective causes on failure modes, the most cost-effective one should be selected.[4] Therefore, in this study to determine the proposed strategies, "theory of problem solving by an inventive method" was used. In this study, most preventive actions in the selected processes of emergency surgery were placed in the strategy category of human resource management.

Strategies of human resource management are the primary solutions that help the organizations to develop skills, attitudes and behaviors of individuals as well as the optimum performance to achieve the organizational goals.[36] Through this strategy, senior managers of treatment section identify and develop strategies for the issues related to human resources.[37] Wong and Beglaryan[37] and Ebrahimipour et al[9] used the strategy of human resources management as the most important strategy to improve patient safety and reduce clinical errors.

Generally, HFMEA as one of the risk evaluation models in a healthcare and treatment organization should be implemented. One reason for maintaining a continuous HFMEA process is that through reducing failure modes risks it is probable to change another failure risk. Thus, after taking measures for improvement and recovery, reviewing risk level scores is deemed necessary both for monitoring the measures' efficiency rate and determining the established changes in other failure indices in relation to the improved failure. Estimating the final effects of the immunity resulting from the electronic medical documents system in an intensive care unit indicated that HFMEA

would reduce the risks of interactions between nurse-physician-physician-tables through calculating the risk rank based on the electronic medical documents system, whereas the physician-patient interactional risks in the examination and evaluation stage and nurse-table would be increased.[38] Therefore, while immunity improvement can bring about performance improvement in other dimensions, it can also be a negative impact on the other performances. Therefore, while investigating the reviser recommendations and suggestions from risk evaluation model, the exact survey of the relationship between enhanced immunity, timing of implementation feasibility and amount of affordability is necessary.[14]

Eventually, HFMEA usefulness has been approved in redesigning treatment and healthcare processes. For instance, Dewe and his colleagues[39] used HFMEA in the intensive care unit and they realized that the successful application of this method is related to strong and efficient leadership and continuous commitment. Latino and Spath[40] also reported the importance of organizational leadership and management in the application of risk management methods.

Thus, the implementation of strategies and proposed actions has a strong relationship with the participation of individuals and financial and administrative support.[32,41] Duwe et al[42] reported that the successful implementation of prospective risk assessment programs is related to the strong leadership and continuous commitment.

One of the limitations of this study is that the amount of real failure cannot be determined in HFMEA studies [43] and the points of team members are based on their minds. Also, in HFMEA studies, it is difficult to show the reduction of adverse events after interventions and to prove the improvement of patient safety and cost-benefit analysis with HFMEA programs.[26]

"Creation and revision of the approaches and a clear implementation method", "education of the patients and patients' participation in treatment process", "revision and re-engineering of processes", "basic analysis of the events and report of the critical results", "continuous monitoring and control of the working stages", "improvement of team communication", "check-list of maintaining and management of equipment", "development of the evaluation criteria of staff performance", and "adapting workload with the staff" should be applied for optimization and to improve the quality of emergency surgical processes. Finally, the effectiveness of the mentioned method in the implementation step was not tested in this study.

In conclusion, using HFMEA to identify the possible errors of treatment processes, causes of each failure mode, and strategies of improvement is highly effective, and prospective risk analysis in healthcare sector is proposed to transmit an organizational culture from the type of reaction to the type of error prevention.

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